INTRODUCTION

On the West Side of the San Joaquin Valley, floodwaters from Panoche and Silver Creeks have historically created flooding and sedimentation problems for Mendota and surrounding agricultural lands. Not only have the floodwaters caused serious problems for Mendota, but the sedimentation impacts from each flood continue to deposit watershed sediments on the Panoche Creek alluvial fan. The Panoche/Silver Creek Watershed is a principal source of selenium, salts, and other trace elements, which continue to contaminate the soils and groundwater in the Panoche alluvial fan and the San Joaquin River. Although drainage water management is improving on the agricultural lands, the ongoing Panoche/Silver Creek flooding and sedimentation continues to exacerbate the Grassland agricultural drainage problems.

Numerous studies have been prepared over the last 25 years defining the problem and proposing solutions to minimize the flooding impacts from Panoche/Silver Creek. All of the studies determined a major solution to the flooding problems would be costly, and the economic analyses determined the benefits of a project were not great enough to justify the costs. As a result, the reports, one by one, were put on a shelf while the floods continue to impact Mendota and the agricultural lands.

In 1989, a Coordinated Resource Management and Planning (CRMP) program was formed. The CRMP team includes residents of Mendota, ranchers in the upper watershed, farmers in the lower watershed, the Silver Creek Drainage District, local water district officials, the Westside Resource Conservation District, the U.S. Bureau of Land Management, the U.S. Bureau of Reclamation, the Natural Resources Conservation District, and the California Department of Water Resources. The CRMP goal is to balance existing land use practices and develop realistic management strategies to reduce future water quality problems, erosion, and flooding impacts in the Panoche/Silver Creek watershed. There is a strong desire to develop proposals, which will reduce the sediment and selenium loading on the Panoche Creek alluvial fan.

INTRODUCTION

After receiving an EPA grant in 1995, the CRMP team hired a coordinator to further improve and coordinate the planning efforts. Presently, CRMP has hired a consultant to perform a Sedimentation Study to analyze and evaluate the sediment movement occurring in the watershed. A final report on this study should be available by the end of August 1998. CRMP is also coordinating a Clinic Program through the School of Agricultural Science and Technology at California State University Fresno. The purpose of this project is to develop options for better erosion and sediment management in the Panoche Creek channel. This project began in January 1998 and will conclude in December 1998.

This report is an additional project goal of the CRMP program. The purpose of this report is to summarize the historic Panoche/Silver Creek flooding problems, review the long-term watershed management options proposed by the CRMP team, recommend a flood control proposal to minimize the flooding impacts, and develop a preliminary estimate of cost for the flood control proposal. The report also includes a project budget for the preparation of a feasibility report, NEPA and CEQA documentation, and future operation and maintenance costs for the proposed flood control proposal. The project budget will be the basis for obtaining additional funding to proceed with the recommended flood control proposal.

WATERSHED

General

The Panoche/Silver Creek Watershed is depicted on Plate 1. The watershed is located on the West Side of the San Joaquin Valley in Fresno County and extends up into the Diablo Mountain Range in San Benito County. Interstate 5 generally bisects the watershed. The portion to the west is referred to as the upper watershed and the portion northeasterly of Interstate 5 as the lower watershed. The total watershed encompasses an area of approximately 291,500 acres (455 square miles). The upper watershed (181,000 acres or 283 square miles) consists of numerous different creeks and subwatersheds, which drain into the two primary tributaries, Panoche Creek and Silver Creek. The lower watershed, approximately 110,500 acres (172 square miles), follows the approximate boundaries of the 100-year floodplain.

Nearly two-thirds of the land use in the upper watershed is rangeland used for grazing of both sheep and cattle. The Bureau of Land Management manages public lands which represent nearly 30 percent of the upper watershed, for grazing, recreation, mining, and the protection of sensitive resources. There are close to 55,000 acres of public land in the upper watershed in grazing allotments. Historically there have been approximately 5,000 acres of highly productive agricultural land irrigated and dry farmed in Panoche Valley. Several abandoned mercury mines are also located in the upper watershed.

Topography

The Panoche Creek alluvial fan rises from an elevation of 165 feet at Mendota to an elevation of 460 feet at Panoche Creek and Interstate 5. The foothills just west of Interstate 5 slowly rise as they follow the Panoche Creek and Silver Creek tributaries up into the Diablo Mountain Range reaching a maximum elevation of approximately 5300 feet. About two-thirds of the upper watershed drains into Panoche Creek and one-third into Silver Creek.

Climate

The climate in the watershed is characterized by a mild spring and fall, warm summers and cool winters. There is some fog in the lower watershed during the winter months and moderate precipitation. Average annual precipitation is approximately 8 inches in Mendota and 16 inches in the upper watershed. Precipitation generally occurs between October and April and is rare during the summer months, which makes irrigation so vital for agricultural production.

Cities

Plate 1 indicates the location of Mendota (population 7,600) and Firebaugh (population 6,100). They are the only major urban areas in the watershed. Residents of both communities are primarily dependent on the local agricultural economy for their livelihoods.

Agriculture

Agricultural production adjacent to Interstate 5 includes almonds, grapes, and row crops shifting to more salt tolerant cotton and grain crops as one moves further downstream below the California Aqueduct. The current channel of Panoche Creek below Interstate 5 is located within Westlands Water District. The Broadview Water District is located northerly of Ashlan Avenue, and the Firebaugh Canal Water District is located in the lowest part of the watershed between Mendota and Firebaugh. The land in the Firebaugh Canal Water District has been irrigated for agricultural production since the early 1900's. The land in the Broadview and the Westlands Water Districts have come under intensive irrigation following completion of the Delta Mendota Canal in the 1950's and the Central Valley Project, San Luis Unit, in the late 1960's. The location of each water district and the boundaries of the Silver Creek Drainage District, which oversees and manages drainage issues in the lower watershed, are shown on Plate 2.

Hydrology

Panoche Creek drains approximately two-thirds of the northerly portion of the upper watershed westerly of Interstate 5 (189 square miles). It begins near Panoche Pass at an elevation of 2,200 feet and flows through Panoche Valley before being joined by Silver Creek approximately 4 miles upstream of Interstate 5. Panoche Creek's primary tributaries in the upper watershed are Bitterwater Canyon, Los Aguilas Canyon, and Griswold Creek. Silver Creek drains the southerly one-third (99 square miles) of the upper watershed in the steep rugged Diablo Mountain Range. The creeks flow through steep well-defined canyons in the upper watershed.

After leaving the foothills a few miles west of Interstate 5, Panoche Creek flows in a northeasterly direction across the Panoche Creek alluvial fan towards the San Joaquin River. Once Panoche Creek has passed over the California Aqueduct siphon, approximately 5 miles downstream of Interstate 5, the alluvial fan becomes relatively flat and the channel reduces in size and capacity. Historically, flows have broken out of the existing channel in the reach below the aqueduct. Farmers in this reach have done some channel realignment and have constructed levees along the sides of the channel in an attempt to keep the flows within the creek. At the present time, the existing channel abruptly ends at Belmont Avenue. Smaller flows are diverted down Belmont Avenue towards Mendota, but larger flows continue in a northerly direction across developed agricultural land, diverted in different directions by existing roadways, levees, and canals.

Historic streamflow records are incomplete for the Panoche/Silver Creek watershed. The United States Geological Survey (USGS) measured annual flows on Panoche Creek and Silver Creek just upstream of the confluence during the 1922–23 water year. No additional flow measurements were made until the *Panoche Creek below Silver Creek Gaging Station* was constructed below

the confluence of Panoche Creek and Silver Creek during the 1950 water year. Panoche Creek flow monitoring continued at this gaging station through 1974. The USGS, in late 1997, installed a new gaging station at Panoche Creek and the Interstate 5 bridge.

A review of the 1922-23 flow records provides some interesting hydrologic information. During this year of flow measurement, the total upper watershed runoff was 2,320 acre feet. The flow records indicate that approximately 60 percent total runoff came from Silver Creek, which only drains approximately one-third of the upper watershed area. One possible explanation for this is that there are greater percolation losses in Panoche Creek as it flows through the Panoche Valley. Silver Creek is located in a more mountainous area and is assumed to have less percolation losses. The flow record indicates the percentage of the total flow contributed by Silver Creek begins to decrease as the annual precipitation increases during the winter. Another explanation is the storms crossing the watershed in this one year had greater precipitation in the Silver Creek watershed.

The United States Bureau of Reclamation (USBR) originally developed flood frequency analyses of Panoche Creek as part of the California Aqueduct cross-drainage studies in the early 1960's. The USBR and the U.S. Army Corps of Engineers (COE) have updated these analyses in additional flood studies of the Panoche/Silver Creek watershed. Peak flows and flood volumes downstream of the Panoche and Silver Creek confluence were estimated in 1981 as follows:

Flood Frequency (yrs)	Peak Flow (cfs)	Volume 1-Day (acre-feet)	Volume 3-Day (acre-feet)	Volume 10-Day (acre-feet)
10	3,750	1,260	1,920	2,440
25	7,740	2,770	4,480	5,760
50	12,300	4,460	7,410	9,670
100	18,700	6,740	11,300	15,100

HISTORIC FLOODING IMPACTS

The precipitation, peak flow, and annual runoff can vary significantly from year to year in the Panoche/Silver Creek watershed. During the 1987-92 drought the annual precipitation in the watershed dropped significantly. In 1989 the precipitation was approximately 40 percent of the annual average. During these years there was no significant runoff from the watershed, and therefore, no flooding. However, during the last 6 years with above normal precipitation, there have been 4 years when Panoche Creek peak flows created flooding problems. Table 1 summarizes the hydrology for the known Panoche Creek flood years.

Table 1

Years of Flow	Panoche 2W Precipitation (WY inches)	Peak Flow (cfs)	Peak Flow (Date)	Annual Discharge (acre feet)	Source
1950				520	(2), (4)
1952	13.28	3,160	Jan. 12	7,718	(1), (2), (4)
1958	18.49				(4), (3)
1962	10.33			3,633	(1), (2), (4)
1969	14.83	5,400	Feb. 24	12,020	(1), (4), (3)
1973	12.07	1,900	Feb. 11		(1), (4)
1977*	5.18				(4)
1978	19.10	3,350	Jan. 16		(3), (4), (5)
1983	19.63				(3)
1986	13.70	3,000	Feb. 17 & Mar. 20	12,300	(3)
1993	16.54	2,000	Jan. 17	14,000	(3)
1995	21.59	7,000	Mar. 10	25,000	(3)
1997	11.34	1,800			(3)
1998	21.68	6,500**	Feb. 3		(3)

3

4 * 4.69” Sept. 1976 which, if added to WY 1977, Precipitation = 9.87”

** 17,000 cfs per USGS

Sources:
(1) USGS Water Resources Data
(2) USGS Streamflow Records
(3) Records of Don Moss, Superintendent, Firebaugh Canal Water District
(4) USBR 1981

(5) COE 1994

Over the last 45 years, there have been at least eight floods with estimated peak flows exceeding 2000 cubic feet per second. Although Panoche Creek flooding has occurred for many years, recent flood events appear to have caused substantially greater damages. Impacts from this flooding are summarized below.

Upper Watershed

The soils in the upper watershed have a high erosion potential and during periods of heavy runoff erosion is a common occurrence. Field observations have determined erosion is significant in the Panoche, Tumey, and Griswold Hills areas of the watershed. Many scarps and areas of unstable soil are evident in the upper reaches of Silver Creek. Bank sloughing is also common and can be attributed to the heavy precipitation and resulting peak flows, which occur during the flood years. The heavy precipitation, peak flows, and resulting erosion in 1998 have significantly scoured the riparian habitat of the creek channels. The eroded sediments have been transferred down the respective tributaries causing significant sedimentation to occur in the lower watershed. Sloughing and erosion of the Panoche Creek channel occurred during the 1998 storms upstream of Interstate 5. Plates 3 through 5 are photographs showing the Panoche Creek channel at Interstate 5 during the peak 1998 flows and additional photographs depicting the upstream channel erosion in the Silver Creek and Panoche Creek channels. The continued sloughing and erosion of the channel embankments continues to degrade the wildlife habitat.

City of Mendota

Mendota is usually impacted when Panoche Creek flood flows reach Belmont Avenue. A portion of the floodwater, which does not sheet flood northerly across Belmont Avenue is directed easterly down Belmont Avenue towards Mendota. Due to this condition, dirt berms and

sandbags are placed along and across roadways to direct the flows, if possible, through the southerly portion of Mendota and into Fresno Slough. Generally, the quantity of floodwater reaching Mendota is limited by the capacity of the drainage channels on either side of Belmont Avenue. The quantity of floodwater reaching Mendota usually does not vary significantly for floods of different magnitudes. In the past, floodwaters have inundated roughly two-thirds of the city. Primary flood impacts to Mendota have included damage to the city's sewer system and to roads. Some residences and businesses have also been impacted. Highways 33 and 180 have been restricted to single lane traffic when flooding occurs. During 1998 Mendota not only received floodwater from Belmont Avenue flows, but some floodwater backing up on the southwesterly side of the Firebaugh Canal Water District's Third Lift Canal, flowed southeasterly to the Intake Canal (Plate 1). Once it reached the south side of the Intake Canal, it flowed easterly through a culvert at Highway 33 flooding a subdivision in north Mendota.

Five years ago Mendota constructed a new high school facility at the southeast corner of Belmont Avenue and Highway 33. When flooding occurs down Belmont Avenue, it continues past the entrance of the high school. During flood events, access and egress to the school are disrupted. Structural damage to school facilities has been minimized, but damage has occurred to a sewer pump station serving the new high school. A photograph of Mendota flooding impacts is included as Plate 6.

Agriculture

Although Panoche Creek flooding occurs primarily during the winter months, agricultural damages still account for the highest percentage of all flood damages. These damages include total crop losses, lost land preparation costs, silt removal and cleanup costs, land releveling costs, on farm irrigation system damages, delays in crop planting, and reduced crop yields in flood years and future years due to sedimentation impacts. Plates 7 and 8 are photographs depicting

some of the impacts to agriculture caused by flooding.

The natural marine shale formations in the upper watershed have high concentrations of salts, selenium, boron, and other trace elements. The long term weathering and eroding of the shales during flood events has deposited the selenium rich sediments for thousands of years on the Panoche Creek alluvial fan. USGS studies indicate the sediment deposited in recent flooding has tested at 400 parts per billion (ppb) for selenium. Typically, the soluble selenium content in the first major flood event of the year is the highest. The majority of the selenium, however, is being transported to the valley floor in its solid phase, in the sediment. The sediment, high in salts and selenium, continues to be deposited on the valley agricultural lands and is a major concern. Studies suggest flood runoff and the resulting sediment deposits continue to recharge and degrade the perched groundwater quality. This is a serious resource problem impacting the long-term agricultural drainage problems of the Panoche Creek alluvial fan.

Water Districts

The Westlands Water District serves the agricultural land adjacent to Panoche Creek below Interstate 5 to Belmont Avenue (Plate 2). During flood events water supply pipelines have been washed out and replacement required. Some drainage facilities, used for on-farm recirculation systems, have also been damaged by siltation from the flood flows.

The Firebaugh Canal Water District is located at the lower end of the Panoche/Silver Creek watershed between Mendota and Firebaugh (Plate 2). As mentioned, flood flows breaking out of the Panoche Creek channel sheet flood across agricultural land in a northeasterly direction. The district's First, Second, and Third Lift Canals traverse the lower portion of the Panoche/Silver Creek watershed along natural contours in a northwesterly direction. Overland flooding initially backs up against the district's Third Lift Canal before overtopping the canal embankment.

Floodwaters continue down the Third Lift Canal alinement overtopping the canal at existing check structures and road crossings when the canal capacity is exceeded. Depending on the size of the flood, the overland flooding will continue in sequence down to the Second and First Lift Canals and eventually to the Delta Mendota Canal. Sediment is deposited in all of the canals and floodwaters eventually drain down to the Mendota Pool behind Mendota Dam (See Plate 1). Damage occurs to canal levees, canals, district pumps, electrical panels, and the telemetry system. The poor quality floodwater must be drained from the district conveyance system, and the sediment removed, before the system can be used for irrigation purposes.

The Broadview Water District, Plate 2, has approximately one-half of its district located within the Panoche/Silver Creek watershed. When floodwaters sheet flood northeasterly from Belmont Avenue and back up along the upslope side of the Firebaugh Canal Water District Third Lift Canal, the district's drainage canal at this location is usually flooded filling with silt. District drainage pumps and motors have also been damaged and the respective sumps filled with silt.

Other Impacts

In addition to the flooding impacts mentioned above there have been ongoing flood impacts and damage to State and County roads. The Panoche Creek channel at the Interstate 5 bridge experienced some erosion and sloughing of the banks during the 1998 storm activity. Caltrans plans to reinforce the banks with additional riprap. The inverted siphon crossing of the California Aqueduct did not experience any erosion problems during the 1998 storms, but siltation is evident. During the 1998 peak storm flows, however, some erosion did occur to the footings of the Panoche Creek/Fairfax Avenue bridge crossing of the California Aqueduct. At Belmont Avenue, Highways 33 and 180 are often restricted to one lane traffic during flood events and although structural damage is minimized, the storm drains on each side of the highways fill with silt and require cleaning. Ongoing flooding will degrade the quality of the two

State highways reducing their useable life before replacement is required. In addition, the restricted traffic flows create a public safety hazard.

The Southern Pacific Railroad runs northwesterly across the lower end of the Panoche/Silver Creek watershed. Flood waters draining across the Firebaugh Canal Water District canals eventually back up against the railroad tracks. Large floods have the potential to damage the railroad tracks.

Economic Impacts

Over the years Panoche Creek flooding has caused substantial damage severely impacting the local economy. The financial damages have been primarily agricultural in nature, but the flooding has also caused public and private damage in Mendota. Typical financial impacts from previous flood years and known impacts from the 1998 flooding are summarized below.

- **City of Mendota.** In 1976 flooding resulted in significant impacts to the city's sewer system and roads. Estimates provided at that time indicate total city damages of $271,000. Estimates provided by the city for 1998 flood control operations exceed $100,000. There will still be additional cleanup costs for work yet to be completed including some minor residential damage.

- **Westlands Water District.** The Panoche Creek channel easterly of Interstate 5 is located within the Westlands Water District. Several distribution pipelines cross the channel. When large flows occur in the channel many of the pipelines are washed out and have to be removed and replaced. In 1998 the district experienced approximately $75,000 in expenses to repair and replace facilities damaged in the flooding. District staff indicated the expenses are comparable to earlier flood years.

HISTORIC FLOODING IMPACTS

- **Broadview Water District.** Flooding damages to the district were approximately $15,000 in 1995. Staff indicates the flood damage costs for 1998 are approximately $20,000.

- **Firebaugh Canal Water District.** Panoche Creek flooding has the greatest financial impact on this district. When floodwater flows into the district's Third Lift Canal silt deposition and washouts are significant. Cleaning the canals so they will be operable for the irrigation season requires a significant amount of work. The district has purchased two excavators for this ongoing expense. Flood damage expenses have varied from $50,000 to $200,000 depending on the size of the flood. The district's 1998 flood damage expenses were in excess of $100,000.

- **Agriculture.** Flooding of agricultural land continues to cause the greatest economic impact to the area. A 1978 study determined lands inundated by Panoche Creek incurred approximate damages of $225 per acre. A survey was mailed in March 1998 to approximately 30 farmers in the Panoche Creek flood plain to estimate the quantity of land impacted and the estimated damages from recent flooding. Over fifty percent of the surveys were returned. The survey respondents indicated in 1995 over 5,400 acres were flooded with cleanup and lost revenue damages of over $1,800,000. In 1998 the flooded acreage was just over 4,000 acres, and the cleanup and lost revenue damages exceeded $1,500,000. This survey was not official and did not fully represent all of the impacted landowners, but it does provide a reasonable per acre cost of flood damages. The estimated 1998 flood damages (cleanup and lost revenue) have an average cost to landowners of $370 per acre. Previous estimates indicate flooding can potentially impact 6,500 agricultural acres in the 10-year flood and up to 30,000 acres in the 100-year flood. Using the 1998 survey damage cost of $370 per acre, total agricultural damages are estimated to vary from $2,400,000 to $11,100,000

for the 10-year and the 100-year floods.

Agriculture is an important component of the local economy. In 1997, the gross production value of Fresno County agricultural commodities exceeded $3.4 billion[1]. Every dollar received from Fresno County agriculture results in an economic benefit of three and one-half dollars to the total economy[2]. Priority should be given to protecting county agricultural resources. If the contamination to the soils and water continues from the flooding and erosion/sedimentation problems on the Panoche fan, then local agriculture will continue to suffer, impacting its contribution to the county and state economy.

- **Other.** County roads in and around Mendota have been and continue to be damaged by flooding. Repair to these roads is an ongoing program for the Fresno County Public Works Department. Preliminary estimates for 1998 flood expenses are not available, but 1995 expenses exceeded $23,000. Caltrans crews provide additional monitoring, inspection, and cleanup of Highways 33 and 180 during periods of Panoche Creek flooding. The Interstate 5 bridge crossing of Panoche Creek also receives additional inspection. Caltrans maintenance staff indicated once cleanup is complete, approximately $50,000 will have been expended in 1998 for special crews to handle the Panoche Creek flooding problems.

[1] Fresno County Department of Agriculture, 1997 Agricultural Crop and Livestock Report.
[2] Fresno County Department of Agriculture, 1997 Agricultural Crop and Livestock Report.

PROPOSED PROJECT OPTIONS

The Coordinated Resource Management and Planning (CRMP) team has been developing plans for a total watershed management approach to minimize damage to the watershed. The priorities are to decrease destruction of riparian habitat, reduce flood flows, alleviate water quality concerns, and, in general, improve the growth of riparian vegetation in the watershed. The following discussion will summarize the recommended options being considered.

Erosion Control Structures

The CRMP team strongly recommends the construction of erosion control structures on smaller tributaries in the upper watershed. The erosion control structures would consist of small dams constructed on individual creeks to reduce the peak flows continuing on down the watershed to Silver and Panoche Creeks. The small dams would have a restricted outlet to minimize the flow discharged from each site. When large storms occur over the watershed and runoff begins to increase, water flowing down the tributary creeks would reach the dams and back up in the small reservoirs. The restricted outlets would allow a reduced percentage of the flow to continue on down the creeks, but the peak flow would be reduced by temporarily storing the runoff in the reservoirs. After the storms are finished, the reduced flows would continue down the various tributaries until the reservoirs are dewatered. By reducing peak flows, the erosion and sediment transfer down the watershed would be reduced. It is conceivable that the peak flow for the 50-year storm could be reduced by 50 percent with the construction of several erosion control structures in the upper watershed. Plate 9 indicates possible locations for some erosion control structures.

Stream Channel Restoration

The improvement of vegetative growth adjacent to the various creeks in the watershed should improve the riparian habitat and reduce the flows, minimize the erosion problems, and result in

improved water quality benefits. In 1994, the Soil Conservation Service performed an assessment of the existing riparian zone conditions. The oak woodland and chaparral plant communities in the upper watershed were generally found to be in excellent condition. The most degraded riparian habitats were found in the Silver Creek tributaries and along Silver Creek between the Fresno County line and Panoche Creek. The riparian habitat of Panoche Creek below its confluence with Silver Creek has been impacted by an in-stream gravel mining operation as well as off-road vehicle use in and through the area. The riparian zones in the lower watershed below Interstate 5 continue to be well vegetated, however, several non-native plant species have invaded Panoche Creek in this location, as well as the upstream watershed tributaries, impacting the habitat value.

Reasons for the degraded riparian habitat in the Silver Creek tributaries are described as a combination of poor soils, which do not allow adequate vegetative cover and heavy livestock congregation in the riparian areas. The placement of stockwater facilities and salt blocks further away from riparian areas along with possible additional fencing may be beneficial in improving the livestock management of the impacted areas. Making information available on optimum rangeland management practices should assist in improving the vegetation along the riparian habitat.

Working in coordination with the Plant Science Department at California State University Fresno, the CRMP team is proceeding with a Panoche/Silver Creek Clinic Project, which will restore and revegetate reaches of Panoche Creek between Interstate 5 and the California Aqueduct. Students have selected plant seedlings from throughout the watershed and will propagate them for planting in the fall of 1998. Various restoration and revegetation techniques will be developed and evaluated. The goal of the project is to develop a program for improving the Panoche/Silver Creek riparian habitat so creek flows will be contained and erosion reduced in the most cost-effective manner possible.

Flood Control Dam

Several studies have reviewed the possibility of constructing a dam downstream of the Panoche/Silver Creek confluence to manage and control the high runoff from the Panoche/Silver Creek upper watershed. The construction of one dam to minimize Panoche Creek flooding concerns would be desirable. Geologic evaluations were conducted on Panoche Creek by the United States Bureau of Reclamation during the California Aqueduct cross-drainage studies in 1963. Although some geologic difficulties were found, the report states, "…this preliminary study shows that an earthfill dam of desired height can be efficiently built and operated if these geologic difficulties are fully appreciated in the final selection of the axis and if the geologic investigation for final design is painstakingly thorough."[3]

One flood control option is the construction of a single flood control dam capable of handling the 50-year flood event. Plate 9 indicates the proposed location of a single flood control dam. The facility would be a homogenous earthfill dam with riprap slope protection, appropriate cutoff walls, foundation treatment, spillway, and outlet works. The dam would have a total storage capacity of approximately 18,000-acre feet. Capacity for future sediment storage would be approximately 8,000-acre feet.

Floodway

It is unrealistic to assume that both upstream erosion control structures and a flood control dam would be constructed to control Panoche/Silver Creek flooding. A detailed feasibility study including a review of the hydrologic data will be required to analyze the benefits of each

[3] "Interim Report on Geologic Investigations (February-July 1963) For Panoche Creek Dam," U. S. Bureau of Reclamation, September 1963.

proposal. Possibly a reduced number of smaller erosion control structures in combination with a smaller flood control dam would be the optimum solution for minimizing the Panoche/Silver Creek flooding impacts. In either case, a floodway to pass reduced flood flows or controlled releases across the lower watershed to Fresno Slough will also be needed to minimize flood impacts in the lower watershed.

If only erosion control structures are built in the upper watershed, and the desired level of flood protection is the 50-year flood event, then a floodway capacity of approximately 6,000 cfs would be required. This assumes that the erosion control structures would be designed to reduce the peak flow during the 50-year flood event by approximately 50 percent. If a flood control dam is constructed to handle the 50-year flood event, then a floodway channel design of 500 cfs may be adequate to handle controlled releases from the reservoir following a peak storm.

1. Erosion Control Structures Proposal. This proposal assumes erosion control structures are constructed in the upper watershed, and a floodway is required capable of passing a flow of 6,000 cfs across the lower watershed to Fresno Slough. If 5-foot high embankments are constructed to contain the flood flows with 2 feet of freeboard, then a floodway width of approximately 700 feet would be required. To reduce the scour velocities, the channel slope would need to be slightly less than the slope of the natural ground. This would require the installation of small gabion drop structures at appropriate locations. A diversion structure in the present Panoche Creek channel would be required to divert the flood flows into the proposed floodway channel. Two bridges are proposed, one for Highway 33 and one for the Highway180 crossing. Paved depressions across the channel are proposed for the other county road crossings. A sedimentation basin would be required to allow silt to settle before discharging the floodwater into Fresno Slough. Plate 9 symbolically depicts the proposed floodway channel.

2. Mendota Proposal. Mendota continues to experience Panoche/Silver Creek flooding. As a small rural city it has continually been one of the San Joaquin Valley communities most often ravaged by flooding. Typically, as previously discussed, flood flows of almost any magnitude will discharge a portion of their floodwaters down Belmont Avenue towards Mendota. No matter how large the Panoche Creek flooding the quantity of floodwaters diverted down Belmont Avenue towards Mendota are often comparable. After several years of almost annual flooding impacts, the Mendota City Council, in March of 1998, endorsed an $8 million flood control proposal, which would reduce their flooding problems. The proposal consists of constructing a 6-mile drainage channel on the south side of Belmont Avenue. Just east of Ohio Avenue, a 3-mile "green belt" channel would be constructed directing the flow south and then east to a 40-acre siltation basin on the eastside of Highway 180 before discharge into Fresno Slough. The city believes this proposal would reduce their annual flooding impacts by 75 percent.

3. Riparian Habitat & Flood Control Corridor Proposal. The U.S. Bureau of Land Management and the U.S. Bureau of Reclamation, working under the Central Valley Project Improvement Act (CVPIA), Land Retirement Program, are in the initial phase of developing a project for the construction of a riparian corridor along the Panoche Creek channel downstream of Interstate 5. Working in conjunction with the CVPIA Land Retirement Program, the proposal would include acquiring land along Panoche Creek to provide flood control, riparian and upland habitat, and water quality improvements. The initial phase of this proposal involves reviewing options to purchase land for the corridor. Initial considerations are to create a meandering 19-mile long by 1-mile wide corridor from Interstate 5 to the Mendota area. This corridor would provide flood control options for Panoche Creek, and would also serve as an open space greenbelt and wildlife corridor between the upper watershed and the Fresno Slough/San Joaquin River corridor.

PROPOSED PROJECT OPTIONS

Summary. The three floodway or drainage channel proposals, mentioned above, are not necessarily separate proposals being developed by different entities. Each entity has the common goal of minimizing flood impacts from Panoche Creek. The CRMP, Mendota, and the federal agencies each have a desire to cooperate together to reach a mutually acceptable solution for reducing Panoche Creek flooding. It is conceivable that a combination of the three proposals may be the optimum solution for mitigating the flooding impacts. The Mendota proposal has been developed and endorsed by the city council to mitigate the long-term impacts suffered by the city. They are anxious to move ahead, but as in all of the proposals, a funding source is needed to move forward. If a different, large-scale watershed proposal is developed, which will mitigate Mendota's flooding problems as well as those of the neighboring agricultural lands, then it is anticipated the city will willingly join in support. The final recommended proposal may be the Riparian Habitat & Flood Control Corridor or some other floodway channel, modified as required, which will provide the most efficient and cost effective floodway protection possible.

BENEFITS OF PROPOSED PROJECT OPTIONS

The primary benefits of the proposed project options are watershed habitat enhancement and the long-term reduction of flooding impacts to the agricultural lands and the city of Mendota on the Panoche Creek alluvial fan. The benefits manifest themselves in many different ways as summarized below.

Upper and Lower Watershed Enhancement

The construction of erosion control structures in the upper watershed will significantly reduce the peak flows in the tributary streams, proportionately reducing the present erosion and sediment transport occurring. Stream channel restoration efforts will determine optimum revegetation techniques for enhancing the riparian habitats. This will include the gradual elimination of non-native plant species, which have invaded the watershed. Additional review and possible improvement in livestock management strategies throughout the most impacted areas of the upper watershed have the potential to further enhance riparian wildlife habitat values, by reducing erosion, and improving water quality in the tributary streams.

Agricultural Land Use

Following the development of the Central Valley Project, San Luis Unit, there was an increase in agricultural land use on the Panoche Creek fan when additional irrigation supplies became available. Flooding from Panoche Creek has occurred for many years, but the flooding during the last 30 years has resulted in substantially greater agricultural damages. Reducing the potential for flooding will significantly reduce the risk and economic impact of floods on the Panoche Creek alluvial fan.

Grassland Bypass Project (Subsurface Drainage Problems)

The Panoche/Silver Creek Watershed has been identified as a primary source of salts, selenium, boron, and other trace elements contaminating the soils and groundwater in the agricultural areas of the Panoche Creek alluvial fan. The selenium from the Panoche fan within Westlands Water District resulted in the subsurface drainage problems and selenium contamination at Kesterson Reservoir in the early 1980's. In September 1996, the Grassland Area Farmers initiated the Grassland Bypass Project to remove unusable agricultural drainage water from the channels in the Grassland area including Salt Slough, and bypass the drainage flows around the Grassland Water District. This project included utilizing the northerly 28 miles of the existing San Luis Drain, and then discharging the water to the San Joaquin River. The drainage area discharging to the Grassland Bypass Project is northerly of Westlands Water District but also includes a part of the Panoche alluvial fan which has caused high selenium levels in the drainage water. The Grassland Area Farmers have been working aggressively to achieve the water quality objectives for the San Joaquin River and other channels as established by the Regional Water Quality Control Board. Numerous irrigation and drainage system improvements have been implemented by the Grassland Area Farmers to reduce the drainage flows. As part of the Use Agreement with the U. S. Bureau of Reclamation, selenium load limitations were placed on the discharge conveyed through the Grassland Bypass Project. When Panoche/Silver Creek floods, a portion of the floodwaters discharge to the Grassland Bypass Project.

The construction of the proposed project options will minimize flooding impacts to the Panoche fan. Mitigating or reducing the transport of watershed floodwater and sediments to the alluvial fan should provide significant long-term drainage benefits by reducing the source of selenium to the Panoche Creek alluvial fan. It is difficult to quantify this benefit, but with project options in place to reduce flooding impacts, the long-term selenium levels should gradually begin to reduce in the subsurface drainage waters.

City of Mendota

Mendota is a small rural community and the vast majority of the residents are heavily dependent on the agricultural industry for employment. During the winter months when agricultural work is reduced the unemployment rate for Mendota has reached 42 percent. The flooding of agricultural land further aggravates the unemployment problem by delaying the time when full agricultural employment occurs. For many farmers the 1998 flood cleanup, land releveling, and other preparatory work delayed the normal agricultural employment activities by almost two months. This is a serious socioeconomic impact to the residents and city of Mendota.

Reduced flooding would be a tremendous economic benefit for the city and would allow them to redirect their limited budget to other more pressing concerns. The proposed project options would basically eliminate any flooding to the residents and businesses in Mendota. Access to the city on Highways 33 and 180 will no longer be impacted by flooding, and flooding impacts to Mendota High School will be reduced.

County/State Infrastructure

County roads and long term maintenance have been impacted by Panoche Creek flooding. The proposed project options will reduce the damage and maintenance costs for Fresno County roads in the flood plain. The project options will also reduce the long-term maintenance problems experienced by Caltrans at Highways 33 and 180. The Interstate 5 bridge crossing of Panoche Creek has handled the flood flows occurring during the last 30 years, but the proposed project options will further reduce the potential for significant erosion or undercutting problems at this crossing. Reducing Panoche Creek flows will also provide greater protection to the California Aqueduct where it siphons under the creek. There have not been any significant problems to

date, but increased protection would be welcomed.

PROPOSED PROJECT OPTIONS ESTIMATE OF COST

Numerous studies have been prepared through the years with cost estimates for various dams, floodways, and other proposed project facilities to reduce the Panoche Creek flooding impacts. Preliminary cost estimates have been prepared for the construction of typical erosion control structures. The cost estimates for previously proposed flood control dams and floodway proposals have also been reviewed. These costs have been revised and inflated, as required, to provide a realistic estimate of the anticipated project components and their related costs. The estimated construction costs for the proposed project options are summarized below.

- **Erosion Control Structures.** (Goal – Reduce 50-year Peak Flow by 50 percent)
  Furnish and install 8 each Erosion Control Structures in upper watershed
  Estimate of Cost 8 each at $1,600,000 = $12,800,000

- **Flood Control Dam.** (Goal – Provide Protection from 50-year Flood Event)
  Construct one Dam on Panoche Creek below the confluence with Silver Creek
  Estimate of Cost = $30,000,000

- **Floodway.** (Goal – Provide Floodway channel to handle 6,000 cfs flow.)
  Construct 700-foot wide flood channel from Panoche Creek to Fresno Slough.
  Estimate of Cost = $23,000,000

PROPOSED PROJECT BUDGET

Feasibility Study

A feasibility study for the Proposed Project Options will be required to refine the project recommendations and cost estimates for the proposed facilities. The feasibility study will involve a detailed review of an existing hydrologic model of the watershed prepared for the U. S. Bureau of Reclamation in the early 1990s. The hydrologic data would be used to review flood routing and recommend the optimum number and size of erosion control structures in the upper watershed and/or the size of the flood control dam needed to protect the lower watershed from the 50-year flood event. Geotechnical investigations will be required at all proposed sites for the erosion control structures, the flood control dam, Panoche Creek diversion dam, and the floodway bridge crossings. Preliminary schematic designs would be prepared for all proposed facilities. It is estimated the feasibility study cost will not exceed $700,000.

CEQA and NEPA Documentation

Environmental assessments and evaluations have already been prepared summarizing the existing vegetation, wildlife, rare and endangered species, air quality, and water quality in the Panoche/Silver Creek watershed. Many of the existing reports will be useful in preparing the required environmental documentation for the proposed project options. Nevertheless, it is anticipated that significant work is still required to prepare an acceptable environmental impact report/statement meeting the CEQA and NEPA requirements so construction of the facilities described in the Proposed Project Options can proceed. It is estimated the CEQA and NEPA documentation cost will not exceed $220,000.

Future Operation and Maintenance Costs

The proposed project facilities will require ongoing operation and maintenance to maintain the

new project facilities in an operable condition. Reviewing operation and maintenance costs from previous studies, the following annual operation and maintenance costs for the proposed project facilities have been estimated:

Erosion Control Structures	**$3,500 each**	**x 8**	**=**	**$28,000.**
Flood Control Dam				**$32,000.**
Floodway				**$62,000.**